Claims:

1. A data structure in which items of data are stored for search, comprising:

a tree structure in which the items of data are stored except for a portion of the items of data corresponding to a sub-tree structure, which is a selected portion of an assumed tree structure formed by all the items of data; and

an equivalent table storing the portion of the items of data in table form.

2. The data structure according to claim 1, wherein

the tree structure includes a plurality of nodes, each of which is composed of a node information flag, a plurality of pointers each corresponding to predetermined branches, and related information, wherein each of the pointers indicates one of its child node, the equivalent table, and NULL, and

the equivalent table includes a plurality of entries, each of which is composed of a table node information flag, a tail entry flag, a data bit string, a search bit length, and related information.

3. The data structure according to claim 2, wherein the data bit string is arranged so that a length of the data bit string is equal to that of search data, wherein the search bit

length indicates a length of an original data bit string to match with the search data.

4. The data structure according to claim 2, wherein the entries in the equivalent table are stored at consecutive locations in a memory.

5. The data structure according to claim 1, wherein the sub-tree structure is selected so as to satisfying the following conditions a) and b):

a) an amount of memory required to store the data structure is smaller than that required to store the assumed tree structure; and

b) search performance of the data structure is not lower than that of the assumed tree structure.

6. A method for constructing a data structure in which items of data are stored for search, comprising the steps of:

a) forming an assumed tree structure in which all the items of data are stored:

b) sequentially selecting a node from the assumed tree structure to select a sub-tree structure designated by the selected node;

c) forming an equivalent table storing a portion of the items of data corresponding to the selected sub-tree structure in a table form;

d) determining whether the selected sub-tree structure satisfies the following conditions: 1) an amount of memory required to store a data structure including the equivalent table in place of the selected sub tree structure is smaller than that required to store the assumed tree structure; and 2) search performance of the data structure is not lower than that of the assumed tree structure; and

e) when the selected sub-tree structure satisfies the conditions (1) and (2), replacing the selected sub-tree structure with the equivalent table to construct the data structure.

7. The method according to claim 6, wherein

the condition (1) is that, when the selected sub-tree structure is replaced with the equivalent table to form a new data structure, a maximum search time Tmax_t calculated from the new data structure does not exceed a maximum search time Tmax calculated from the assumed tree structure; and

the condition (2) is that, when the selected sub-tree structure is replaced with the equivalent table to form a new data structure, a necessary amount of memory for the new data structure is smaller than that for the assumed tree structure.

8. The method according to claim 7, wherein a decision on whether the condition (1) is satisfied is made depending on

whether the following equation is satisfied:

$$N_D \leqq N_L \times K, \text{ when } K = Te/Tn,$$

where N_D is the number of items of data included in the selected sub-tree structure, N_L is the number of levels of the selected node or lower in the assumed tree structure, Tn is search time per node, and Te is search time per entry in the equivalent table.

9. An apparatus for constructing a data structure in which items of data are stored for search, comprising:

a tree formation section for forming an assumed tree structure in which all the items of data are stored;

a node selector for sequentially selecting a node from the assumed tree structure to select a sub-tree structure designated by the selected node, forming an equivalent table storing a portion of the items of data corresponding to the selected sub-tree structure in a table form, and determining the selected sub-tree structure when it satisfies the following conditions: 1) an amount of memory required to store a data structure including the equivalent table in place of the selected sub-tree structure is smaller than that required to store the assumed tree structure; and 2) search performance of the data structure is not lower than that of the assumed tree structure; and

a data structure formation section for replacing the selected sub-tree structure satisfying the conditions (1) and

(2) with the equivalent table corresponding to the selected sub-tree structure to construct the data structure.

10. The apparatus according to claim 9, wherein

the condition (1) is that, when the selected sub-tree structure is replaced with the equivalent table to form a new data structure, a maximum search time Tmax_t calculated from the new data structure does not exceed a maximum search time Tmax calculated from the assumed tree structure; and

the condition (2) is that, when the selected sub-tree structure is replaced with the equivalent table to form a new data structure, a necessary amount of memory for the new data structure is smaller than that for the assumed tree structure.

11. The apparatus according to claim 10, wherein a decision on whether the condition (1) is satisfied is made depending on whether the following equation is satisfied:

$$N_D \leqq N_L \times K, \text{ when } K = Te/Tn,$$

where N_D is the number of items of data included in the selected sub-tree structure, N_L is the number of levels of the selected node or lower in the assumed tree structure, Tn is search time per node, and Te is search time per entry in the equivalent table.

12. A search system comprising:

a memory storing a data structure in which items of data are stored for search, the data structure comprising:

a tree structure in which the items of data are stored except for a portion of the items of data corresponding to a sub-tree structure, which is a selected portion of an assumed tree structure formed by all the items of data; and

an equivalent table storing the portion of the items of data in table form; and

a search section for searching the data structure for an item of data matching input search data.

13. The search system further comprising:

a tree formation section for forming an assumed tree structure in which all the items of data are stored;

a node selector for sequentially selecting a node from the assumed tree structure to select a sub-tree structure designated by the selected node, forming an equivalent table storing a portion of the items of data corresponding to the selected sub-tree structure in a table form, and determining the selected sub-tree structure when it satisfies the following conditions: 1) an amount of memory required to store a data structure including the equivalent table in place of the selected sub-tree structure is smaller than that required to store the assumed tree structure; and 2) search performance of the data structure is not lower than that of the assumed tree structure; and

a data structure formation section for replacing the selected sub tree structure satisfying the conditions (1) and (2) with the equivalent table corresponding to the selected sub-tree structure to construct the data structure that is stored in the memory.

14. The search system according to claim 13, wherein

the condition (1) is that, when the selected sub-tree structure is replaced with the equivalent table to form a new data structure, a maximum search time Tmax_t calculated from the new data structure does not exceed a maximum search time Tmax calculated from the assumed tree structure; and

the condition (2) is that, when the selected sub-tree structure is replaced with the equivalent table to form a new data structure, a necessary amount of memory for the new data structure is smaller than that for the assumed tree structure.

15. The search system according to claim 14, wherein a decision on whether the condition (1) is satisfied is made depending on whether the following equation is satisfied:

$$N_D \leq N_L \times K, \quad \text{when } K = Te/Tn,$$

where N_D is the number of items of data included in the selected sub-tree structure, N_L is the number of levels of the selected node or lower in the assumed tree structure, Tn is search time per node, and Te is search time per entry in the

equivalent table.

16. A storage medium for used in a search system, storing computer-readable items of data to be searched in a data structure, the data structure comprising:

a tree structure in which the items of data are stored except for a portion of the items of data corresponding to a sub-tree structure, which is a selected portion of an assumed tree structure formed by all the items of data; and

an equivalent table storing the portion of the items of data in table form.

17. The storage medium according to claim 16, wherein

the tree structure includes a plurality of nodes, each of which is composed of a node information flag, a plurality of pointers each corresponding to predetermined branches, and related information, wherein each of the pointers indicates one of its child node, the equivalent table, and NULL, and

the equivalent table includes a plurality of entries, each of which is composed of a table node information flag, a tail entry flag, a data bit string, a search bit length, and related information.

18. The storage medium according to claim 17, wherein the data bit string is arranged so that a length of the data bit string is equal to that of search data, wherein the search

bit length indicates a length of an original data bit string to match with the search data.

19. The storage medium according to claim 17, wherein the entries in the equivalent table are stored at consecutive locations in a memory.

20. The storage medium according to claim 16, wherein the sub-tree structure is selected so as to satisfying the following conditions a) and b):

a) an amount of memory required to store the data structure is smaller than that required to store the assumed tree structure; and

b) search performance of the data structure is not lower than that of the assumed tree structure.

21. A storage medium storing a computer-readable program for constructing a data structure in which items of data are stored for search, the program comprising the steps of:

a) forming an assumed tree structure in which all the items of data are stored;

b) sequentially selecting a node from the assumed tree structure to select a sub-tree structure designated by the selected node;

c) forming an equivalent table storing a portion of the items of data corresponding to the selected sub-tree

structure in a table form;

d) determining whether the selected sub-tree structure satisfies the following conditions: 1) an amount of memory required to store a data structure including the equivalent table in place of the selected sub-tree structure is smaller than that required to store the assumed tree structure; and 2) search performance of the data structure is not lower than that of the assumed tree structure; and

e) when the selected sub-tree structure satisfies the conditions (1) and (2), replacing the selected sub-tree structure with the equivalent table to construct the data structure.

22. The storage medium according to claim 21, wherein

the condition (1) is that, when the selected sub-tree structure is replaced with the equivalent table to form a new data structure, a maximum search time Tmax_t calculated from the new data structure does not exceed a maximum search time Tmax calculated from the assumed tree structure; and

the condition (2) is that, when the selected sub-tree structure is replaced with the equivalent table to form a new data structure, a necessary amount of memory for the new data structure is smaller than that for the assumed tree structure.

23. The storage medium according to claim 22, wherein

a decision on whether the condition (1) is satisfied is made depending on whether the following equation is satisfied:

$$N_D \leq N_L \times K, \quad \text{when } K = Te/Tn,$$

where N_D is the number of items of data included in the selected sub-tree structure, N_L is the number of levels of the selected node or lower in the assumed tree structure, Tn is search time per node, and Te is search time per entry in the equivalent table.